

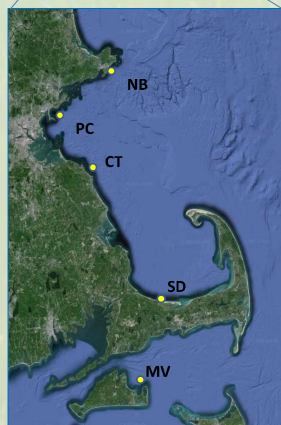
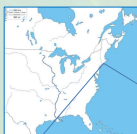
Carbon storage in eelgrass (*Zostera marina*) meadows of Massachusetts, USA

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Rationale

- Carbon sequestration and storage by coastal marine ecosystems has been documented in many areas around the world.
- Currently, limited data exist on the carbon storage potential of seagrass species in temperate areas.
- Our project aims to help fill this geographical data gap by documenting the carbon storage potential of eelgrass (*Zostera marina*) meadows in Massachusetts, USA coastal waters.

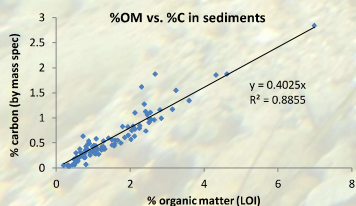
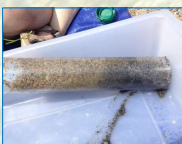


Study sites

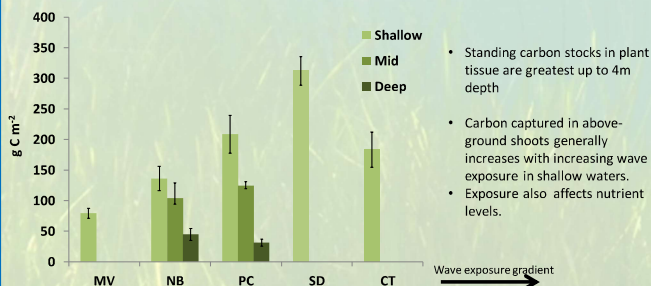
- Two pilot sites in 2014: Niles Beach, Gloucester (NB) and Pirate's Cove, Nahant (PC).
- Five sites in 2015 representing a range of wave and weather exposure conditions: Gloucester (NB), Nahant (PC), Cohasset (CT), Sandwich (SD), and Martha's Vineyard (MV).

Methods

- Mapped dimensions of the meadows and recorded bathymetry either manually or via sonar.
- 10 eelgrass samples and 3 sediment cores were randomly collected from each depth zone: shallow water (0 – 2m MLW), mid-water (2 – 4m MLW), and deep water (4 – 6m MLW).
- 3 sediment cores from a reference site (no eelgrass) at each location also collected.
- Measured shoot density and length in the field.
- Measured eelgrass biomass, sediment bulk density, percent carbon (%C) and nitrogen (%N), stable isotopes (¹³C, ¹⁵N) and percent organic matter (%OM) in shoots and sediments.
- Developed conversion factors for estimating absolute carbon from %OM.

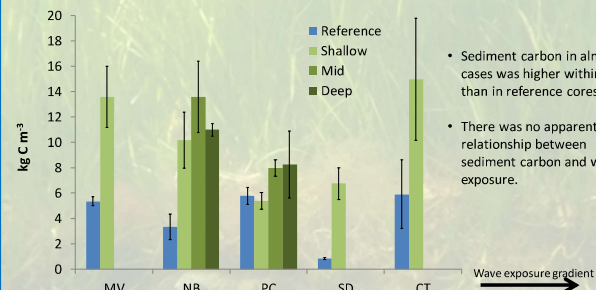


Results: Above-ground carbon (plant shoots)



- Standing carbon stocks in plant tissue are greatest up to 4m depth
- Carbon captured in above-ground shoots generally increases with increasing wave exposure in shallow waters.
- Exposure also affects nutrient levels.

Results: Below-ground carbon (sediment storage)



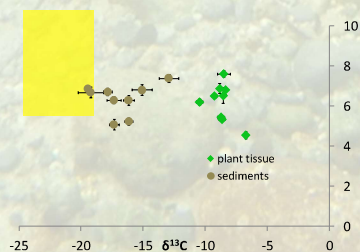
- Sediment carbon in almost all cases was higher within beds than in reference cores.
- There was no apparent relationship between sediment carbon and wave exposure.

Results: Comparison with literature values

	Living Seagrass Biomass Mg C ha ⁻¹ (mean +/- 95%CI)	Soil C _{org} Mg C ha ⁻¹ (mean +/- 95%CI)
North Atlantic	0.85 +/- 0.19	48.7 +/- 14.5
Global Average	2.51 +/- 0.49	194.2 +/- 20.2
This study	0.25 – 3.0	12-50

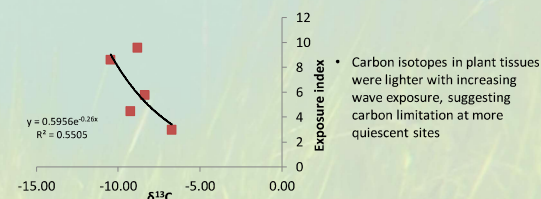
Values reported in literature from other seagrass systems for comparison (data from Fourqurean et al. 2012). 1 Mg C ha⁻¹ = 100 g C m⁻²

Results: estimating carbon source from isotope signatures

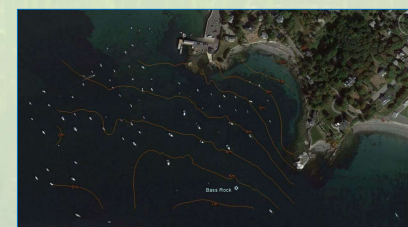


Carbon isotope values suggest C in sediments comes from multiple sources, may include plants and POM deposited in meadows. The yellow box represents the range of C and N isotope signatures reported for POM in the Northeast and Gulf of Maine.

Results: Wave exposure and C limitation



- Carbon isotopes in plant tissues were lighter with increasing wave exposure, suggesting carbon limitation at more quiescent sites



Bathymetry and current extent of eelgrass meadow in Pirates Cove, Nahant

Conclusions

- Eelgrass meadows in Massachusetts hold more carbon compared to un-vegetated habitats. Carbon storage in meadows is comparable to or exceeds values reported from the North Atlantic.
- Carbon is sequestered through both fixation and collection. Stable isotopes suggest carbon stored in sediments does not originate solely from eelgrass, but is likely mixed with phytoplankton and other particulate organic matter.
- The growth of eelgrass may be carbon-limited at some sites. Higher wave exposure was correlated with higher amounts of above-ground organic carbon and with lighter ¹³C values in plant tissues.
- Next steps include expanding work to other areas in New England with a range of environmental conditions and estimating impacts of sea level rise on eelgrass carbon storage capacity.

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